HOUSEHOLD ELECTRIC REFRIGERATION

Including Gas Absorption System

BY

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the float needle (because high-side floats are used in the larger refrigerators).

The slower rate of frost formation on these freezers necessitates less frequent defrosting.

General Electric Model CF-1.—The General Electric *CF* refrigerating unit shown in Fig. 42 is of the same hermetically

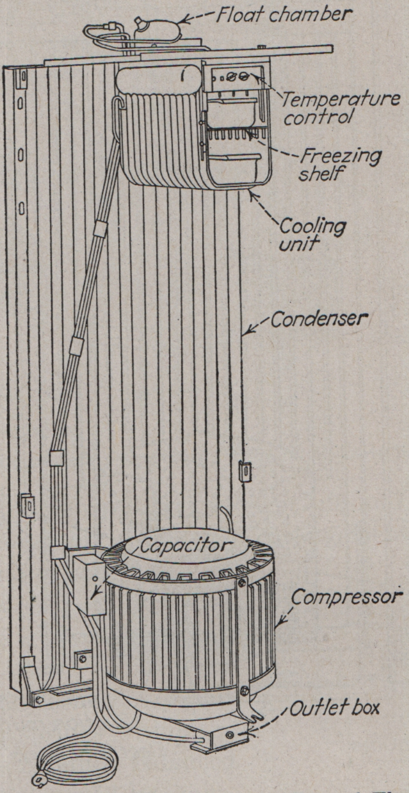

FIG. 42.—Assembly of refrigerating unit for General Electric model *CF*-1.

sealed design as in the Monitor Top line. This *CF* unit is used in the General Electric Flatop refrigerators and differs from the Monitor Top in that the compressor unit is located in the bottom compartment of the cabinet, with a plate-type condenser mounted on the back of the cabinet, and the cooling unit in the upper storage section at the top. The refrigerant used is sulphur dioxide (SO_2). The entire unit is sealed and self-contained. The cycle of operation is illustrated in Fig. 43.

Compressor.—The compressor located on the low-pressure side of the system is of the reciprocating Scotch-yoke type. The compressor case, in which the compressor is sealed, is directly

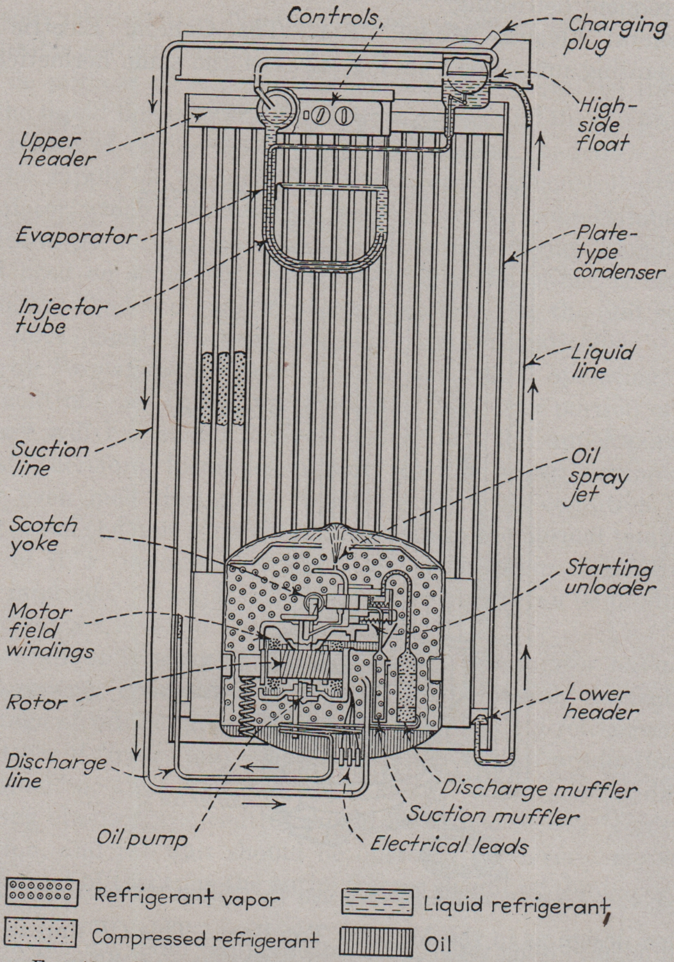

FIG. 43.—Cycle of operation of General Electric model *CF*-1.

connected to the outlet of the cooling unit by an unrestricted tube. The refrigerant vapor contained in the compressor case is consequently always at low pressure.

The compressor is mounted above the motor, as shown in Fig. 44, the reciprocating piston being operated through a yoke

arrangement by the crank on the vertical motor shaft. This construction provides for self-alignment of the bearings, crank-

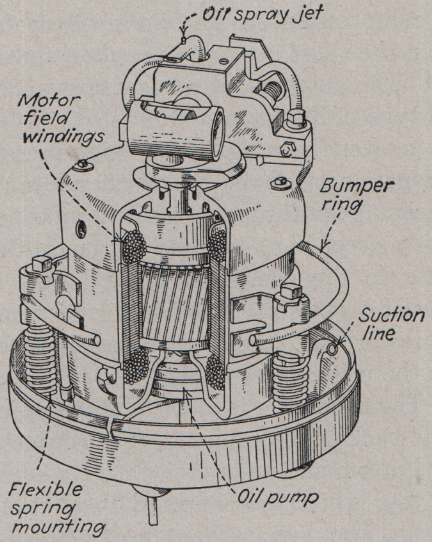

FIG. 44.—Compressor assembly for General Electric model *CF*-1.

pin, and piston, which results in longer life and permits easier machining and assembly. The yoke arrangement and the cylinder construction are shown in Fig. 45. This compressor on tests with restricted suction has built up pressures to 1,000 pounds per square inch. The compressor unit is supported on springs within the steel case and is carefully balanced so that no vibration will be transmitted to the cabinet. Oil under pressure from the permanent supply of oil, contained in the sealed case, lubricates every moving part.

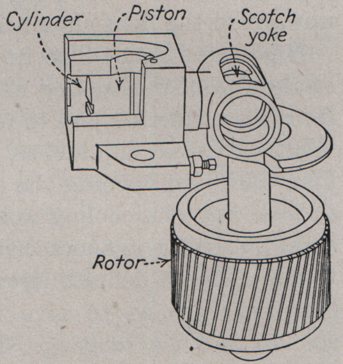

FIG. 45.—Yoke and cylinder construction for compressor shown in Fig. 44.

The low-pressure refrigerant in the compressor case is drawn into the compressor through an acoustic muffler at each stroke of the piston and is discharged through a second muffler on the

compression stroke. These mufflers are designed to eliminate pumping noises, and they assist materially in producing quiet operation of the unit.

During the compression stroke of the piston, a light flapper valve, located in the valve plate at the end of the cylinder, closes the inlet port. The compressed refrigerant vapor is discharged through a disk type of discharge valve as soon as the pressure in the cylinder is greater than that on the high-pressure side of the system. After passing through the discharge muffler, the compressed refrigerant goes through a coiled tube below the compressor assembly (see Fig. 43) and through the drawn-steel compressor base to the condenser plate. This coiled tube is necessary in order to permit the free movement of the spring-mounted compressor unit, thereby preventing the transmission of vibration to the refrigerator cabinet.

Condenser.—The condenser is of the plate type and is mounted vertically on the back of the cabinet. The refrigerant enters the end riser at the bottom and passes upward to a horizontal header, formed at the top, which is connected to all the vertical condenser passages. The vapor then passes downward through the passages to another header formed at the bottom of the condenser, being cooled and liquefied during its passage by the natural convection circulation of the room air over the exterior surfaces of the condenser. The liquid refrigerant then passes upward to the float chamber.

High-side Float.—The function of the high-side float located at the top of the cooling unit is to collect the liquid refrigerant from the condenser and to regulate its flow into the cooling unit. When sufficient liquid has collected in the float chamber, the float ball lifts, opening the needle valve and allowing the liquid to pass into the cooling unit or evaporator. The liquid refrigerant enters the evaporator through a specially designed injector which causes a definite circulation of the refrigerant within the evaporator so as to give the most effective performance in cooling and ice freezing. By extending the float needle and valve down inside the food compartment, an increase in efficiency of from 6 to 7 per cent was obtained.

Evaporator.—The cooling unit whose function is to refrigerate the cabinet is constructed of one corrugated and one flat sheet of stainless steel, electrically line-welded together to form pas-

sages through which the refrigerant flows. These sheets form a cylindrical header at the top of the left side of the cooling unit and a refrigerated shelf which divides the ice freezing compartment so that all the ice trays are in direct contact with freezing surfaces. The injection of the refrigerant into the evaporator results in a scrubber action which, combined with the circulation of the liquid refrigerant, increases the rate of heat transfer and consequently the efficiency of the unit.

The vertical plate extending from the refrigerated shelf on the right side of the cooling unit to the top of the cabinet is a dummy containing no refrigerant and is made of tinned brass.

The direction of flow of refrigerant in the evaporator is shown in Fig. 46. The liquid line from the float valve joins the upper end of the rear channel, which ends at a point just below the header on the left side of the evaporator. The liquid flows through this channel across the bottom of the evaporator. The passage becomes narrower at the lower rear right-hand corner, continues halfway up the right-hand side and then across the shelf. The series path forms a number of loops on the shelf and on the lower part of the right-hand side, ending in a small subheader which extends from front to rear along the bottom right-hand side of the evaporator. From the subheader, small injector tubes lead to parallel pairs of U-shaped channels extending across the bottom, up the left side, and into the main header. The suction line enters at the center of the header with its open end above the liquid level in the zone formed by the baffle, where the surface is relatively quiet.

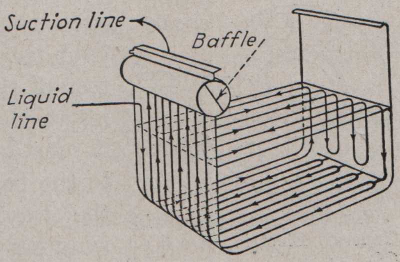

FIG. 46.—Direction of flow of refrigerant in evaporator of General Electric model CK-2.

Motor.—The motor on this unit is of the single-phase induction type. The rotor is pressed on to the vertical motor shaft and rests free in the motor stator. The motor contains a running winding and a starting winding. When the starting switch is turned to the "On" position, the running and the starting windings operate in parallel to start the motor and to bring it up to

speed. As soon as the motor is up to speed, the starting winding cuts out, and the motor operates on the running winding alone.

Lubrication.—Oil, from the permanent supply in the base of the compressor unit, is drawn up by a two-blade rotary oil pump shown in Fig. 47. This pump is mounted on the lower end of the vertical motor shaft. The oil is forced upward through a passage in the center of the shaft from which smaller passages radiate to the lower shaft bearings and to the yoke arrangement. This oil is circulated at the rate of 3 quarts per minute under a pressure of 6 to 8 pounds per square inch.

The major portion of the oil goes to the self-aligning upper bearing and from there to the unloader chamber. It then passes around a groove in the cylinder wall to the top side of the cylinder. At this point a part of the oil is used to cool the discharge valve, the cylinder, and the motor stator. The rest of the oil is sprayed out through a jet to the top of the dome from where it runs down the inside of the case back to the base of the unit, being cooled on the way. The cooling of the stator windings eliminates hot spots and reduces the operating temperature of the windings about 10° to 15°F., thereby increasing their life.

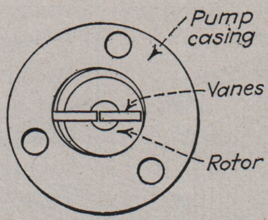

FIG. 47.—Oil pump for General Electric model *CF*-1.

The compressor base forms the bottom of the welded case and contains the three springs which support the compressor assembly and the three metal glass leads which carry the current to the motor. The base also acts as a reservoir for the permanent supply of oil.

Unloader.—The unit is equipped with a pressure-operated unloader which takes the load from the compressor during the stopping period when its speed drops to about 900 r.p.m. (half the rated speed). Likewise when the compressor is starting, the unloader keeps the load off the compressor until it has reached half normal speed. This adds to the life of the compressor by insuring oil pressure on the bearings when the load comes on, thereby reducing the wear on the moving parts. Proper lubrication of the piston is likewise assured. A smaller motor can be used, since the compressor starts under no-load conditions. The unloader also makes it possible to start and stop the compres-

sor with a minimum of vibration. In stopping, the compressor merely idles to a standstill under no load because the load is taken off when the compressor slows down to approximately half speed.

The unloading mechanism, as shown in Fig. 43, consists of a plunger operated by oil pressure and placed in the oil circuit between the upper bearing and the cylinder. When there is no oil pressure in the machine, this plunger, pushed by a spring, moves a smaller plunger which opens the suction flapper valve into the cylinder. The result is that, when the machine is coming up to normal operating speed, the suction valve is being held open and the compressor merely idles because the gas passes out through the suction valve on the compression stroke. When half-speed is reached, the oil pressure has developed sufficiently to force the unloader piston outward against the spring pressure, and in this position the smaller plunger has no effect on the suction valve which now closes and opens only during the regular suction stroke. Likewise as the machine slows down, at approximately half speed the oil pressure has decreased to the point where the spring forces the unloader piston inward, causing the suction valve to be held open. This action permits the compressor to idle to a standstill. The discharge valve acts as a check valve during the unloading periods, preventing the compressed refrigerant vapor from leaking back into the low-pressure side of the system.

Control.—The control device consists of a manual switch, an automatic switch, a motor protective device, and an arrangement for defrosting. The manual switch is used to throw the unit on and off by hand. The automatic switch is operated by a thermostat to automatically start and stop the motor-compressor unit in response to temperature changes in the cooling unit when the manual switch control is in the "On" position.

The motor overload protective device is designed to open the main contacts if the motor current is excessive for too long a period. This device is of the soldered ratchet-wheel type with a series coil on the ratchet spindle. When the current in the coil is excessive, the spindle gets hot and melts the solder holding the ratchet wheel. As soon as the wheel is released it slips and opens the main contacts. The overload device has to be reset by hand by turning the main switch knob to the "On" position, which automatically resets the ratchet and starts the unit.

The defrosting arrangement permits the evaporator to be defrosted without interrupting refrigeration. If the control knob is turned to the defrost position, the temperature of the evaporator rises sufficiently to melt off the frost.

Starting Relay.—The starting relay, consisting of a series coil and an armature, is located outside the compressor case in the

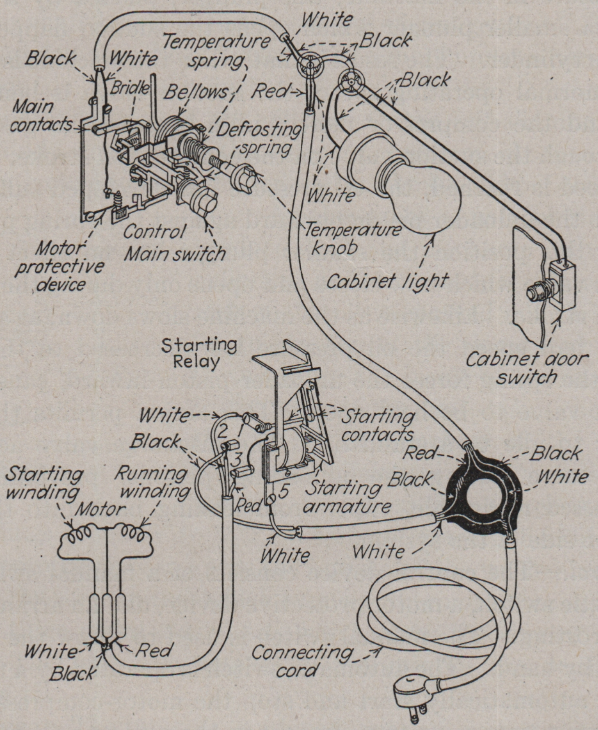

Fig. 48.—Diagram of electrical circuit for General Electric model *CF*.

lower section of the cabinet. The coil is in series with the running windings of the motor, and the armature operates a pair of contacts in series with the starting winding of the motor, as shown in Fig. 48.

When the switch is turned to the "On" position or when the thermostat is operating, the main contacts of the temperature control are closed, and an electrical circuit is completed to the running winding of the motor. When the high starting current passes through the series coil in the starting relay, the armature is

moved outward by the pull of the magnetic field set up about the coil. This motion of the armature closes the relay contacts, putting the starting windings in parallel with the running windings and thus providing the added torque* necessary to bring the motor up to its rated speed. When the motor speed reaches its rated value, the current decreases and the starting relay armature drops, breaking the contacts and allowing the motor to operate on the running winding.

The capacitor or electrical condenser in series with the starting winding is for the purpose of limiting the starting current through the winding. The connectors are of the locking type which cannot be opened accidentally. A connector of this type must be turned before it can be pulled apart. The specifications for the *CF*-1 and *CF*-2 units are the same as the specifications for the *CK*-1*B* and the *CK*-2*B* units which are given in Data Table I.

General Electric CK Unit.—The General Electric *CK* refrigerating unit using sulphur dioxide (SO_2) is of the Monitor Top design and construction. It presents a smooth condenser surface and an easily accessible temperature control. It is designed to occupy little space, eliminate exposed moving parts, reduce the necessity of attention to a minimum, make an interchange of units simple and easy, and provide constant refrigerating temperatures automatically at low cost. It makes use of a hermetically sealed unit, reducing to a minimum the possibility of refrigerant leaks.

This *CK* unit is identical in construction and design with the *CF* model just described except in the condenser construction and the location of the compressor and control units. The cycle of operation in shown in Fig. 49.

The first portion of the condenser surface in the *CK* unit consists of round tubing in contact with the under surface of the cabinet top, which gives added condenser capacity for the unit. From this coil the compressed refrigerant passes to the top part of the condenser assembly and down through the refrigerant passages in the condenser. During its passage the compressed refrigerant is cooled and liquefied. The heat from the gas is absorbed by the room air which passes, by natural convection

* Torque is the measure of a turning effect or a tendency to produce rotation. It is generally expressed in ounce-inches for small motors, or in the number of ounces of force at a given radius.

circulation, over the condenser surfaces. The condenser is formed by line-welding together two plates which are corrugated so as to form continuous passages.

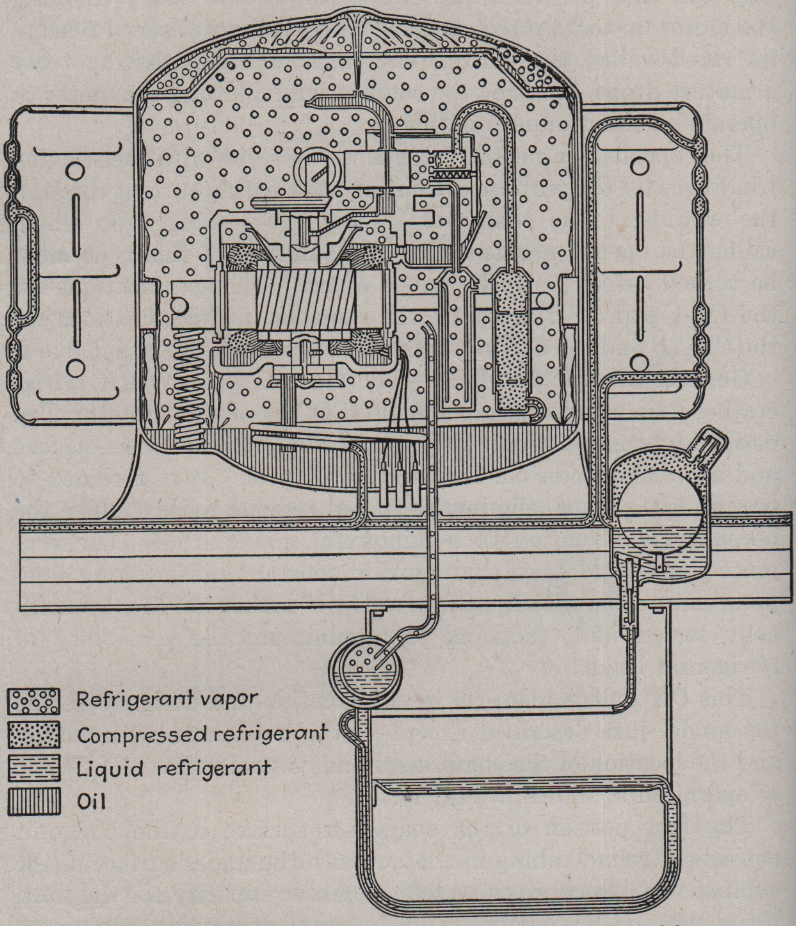

Fig. 49.—Cycle of operation for General Electric *CK* models.

The compressor unit is located on the top of the refrigerator cabinet and, with the cabinet top, forms a complete section which can be removed easily and replaced. This top section merely sits on the refrigerator cabinet.

The control switch is built in to the front center of the Monitor Top condenser and is conveniently accessible for operation.

Data Table I.—For General Electric *CK* Units

Model	Horse-power	Volts	Am-peres, running	Speed, r.p.m.	Refrig-erant charge, pounds	Ice freezing		Weight, net
						Pounds	Cubes	
CK-1*B*	1/8	110	2.2–4.0	1740	1.75	6	40	130
CK-2*B*	1/8	110	2.2–4.3	1740	2.70	10¼	84	143
CK-30*C*	1/6	110	3.3–5.3	1740	2.70	11¼	84	179

Grunow Model H Unit.—The Grunow model *H* refrigerating unit, shown in Fig. 50, is designed for mounting in the base of the cabinet below the storage compartment and uses a high-side float located near the condenser.

Compressor.—The compressor is of the rotary four-blade type and is connected directly to a 1/5-horsepower, 1,750-r.p.m. motor.

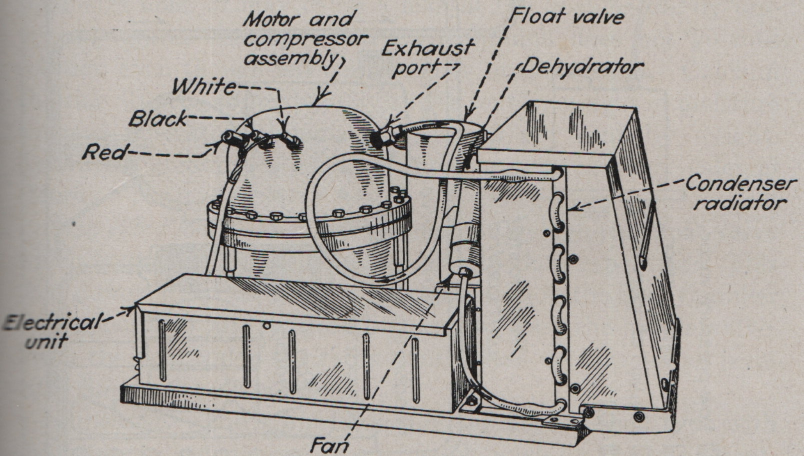

Fig. 50.—Refrigerating unit for Grunow model *H*, base mounting.

This compressor is mounted vertically, in the lower section of a hermetically sealed casing, on the rotor shaft operating at motor speed and is completely submerged in oil. The compressor is flexibly mounted to prevent the transmission of vibrations to the cabinet. Centrifugal action tends to hold the four blades of the compressor rotor against the cylinder walls, pocketing the refrigerant gas and thus producing a pumping action. The